

A word cloud visualization of terms related to science education research. The words are arranged in a circular pattern around a central point. The largest and most prominent words include "science", "students", "engineering", "design", "evidence", "explanations", "models", "questions", "investigations", "problem", "world", "use", "ideas", "scientific", "practical", "phenomenon", "communication", "practice", "sources", "solutions", "range", "theory", "goal", "involves", "ability", "engage", "able", "represent", "performance", "based", "testing", "need", "elements", "physical", "solve", "read", "different", "error", "best", "mathematics", "other", "claims", "argumentation", "computational", "modeling", "communicate", "literacy", "construct", "meeting", "contract", "pattern", "might", "developing", "solution", "content", "problems", "produce", "interact", "relates", "interpret", "include", "various", "critical", "practices", "relevant", "may", "relationships", "features", "used", "often", "also", "engineers", "evaluate", "understanding", "education", "Phenomena", "thinking", "system", "NRC", "educational", "learning", "curriculum", "standards", "assessment", "research".

- 

- **Obtaining Information**
- Asking Questions & Defining Problems
- Plan & Carrying Out Investigations
- Developing & Using Models
- Analyzing Data / Using Math

- Evaluating Information
- Designing Solutions
- Developing & Using Models
- Constructing Explanations

- Communicating Information
- Developing & Using Models
- Arguing from Evidence

**Investigate how the size and/or relative size of a balloon inflated in one breath.**

- ### Individual Performance

- ### Reflection

5. Reflect on the nature of science and how you develop **explanations** based upon **evidence**.

## On your paper:

1. What does this practice **mean**? In your own words.
2. How was this practice **used** in the activity?
3. What **instructional strategies** would you use as a facilitator to support participants in using this practice?
4. What **visual model** would help you to communicate this practice?

## Using a topic you are teaching this month:

1. Can you use this model to engage students with material?
2. For the content you have selected, which of the 8 practices would students engage in?
3. How would each of the practices you identified be used by students in your lesson/unit?

# Grade 12 Goals for Each Practice

Taken from *A Framework for K-12 Science Education* pages 54 – 77. The Framework is available for free as a PDF at [http://www.nap.edu/catalog.php?record\\_id=13165#](http://www.nap.edu/catalog.php?record_id=13165#)

## Asking Questions and Defining Problems

Goals by Grade 12:

- Ask questions about natural and human built worlds
- Distinguish a scientific from nonscientific question
- Formulate and refine questions that can be answered empirically
- Ask probing questions
- Note features, patterns or contradictions and ask questions about them
- Engineering - Ask questions about a need or desire

## Developing and Using Models

Goals by Grade 12:

Construct drawings or diagrams use them as the basis of explanations and predictions

- Represent and explain phenomenon with models
- Discuss the limitations and precision of a model and refine models to improve their quality and explanatory power.
- Use simulations as a tool for understanding and investigating aspects of a system
- Make and use a model to test a design and compare effectiveness of different designs

## Planning and Carrying Out Investigations

Goals by Grade 12:

- Formulate a question that can be and frame a hypothesis based on a model or theory
- Decide what data to gathered, what tools are needed, and how to record measurements
- Decide how much data is required for reliable measurements and consider any limitations on the precision of the data
- Plan procedures, identifying relevant independent and dependent variables and the need for controls
- Consider possible confounding variables

## Analyzing and Interpreting Data

Goals by Grade 12:

- Analyze data to look for patterns or test a hypothesis
- Collate, summarize and display data in order to explore relationships between variables
- Evaluate the strength of conclusions that can be inferred from a data set using appropriate math or statistics
- Recognize patterns in data and distinguish between causal and correlational relationships
- Collect data from physical models and analyze performance of designs under a range of conditions

## **Using Mathematics and Computational Thinking**

Goals by Grade 12:

- Recognize dimensional quantities and use appropriate units in scientific applications of mathematical formulas and graphs
- Express relationships and quantities forms
- Recognize mathematical models that incorporate underlying assumptions about the phenomena or systems being studied
- Use simple test cases of mathematical expressions, computer programs, or simulations to see if they “make sense”
- Use grade-level-appropriate understanding of mathematics and statistics in analyzing data

## **Constructing Explanations and Designing Solutions**

Goals by Grade 12:

- Construct explanations of phenomena using scientific theory and link to models and evidence
- Use primary or secondary scientific evidence and models to support or refute an explanatory account of a phenomenon
- Offer causal explanations and solve design problemsIdentify gaps or weaknesses in explanatory accounts and evaluate and critique design solutions
- Design a plan that meets specified criteria to solve a problem
- Construct a device or implement a design solution

## **Engaging in Argument from Evidence**

Goals by Grade 12:

- Construct a scientific argument with data to support a claim and recognize the features of scientific arguments and distinguish between claims, data and reasons in examples
- Identify weaknesses and flaws in arguments using evidence, modify and improve arguments in response to criticism and read media reports critically to identify strengths and weaknesses
- Explain the controversy in the development of a scientific idea, describe debate that surround it, and why one theory succeeded
- Explain how claims are judged, articulate merits and limitations of peer review and need for replication of investigations

## **Obtaining, Evaluating and Communicating Information**

Goals by Grade 12:

- Use words, tables, diagrams, graphs and mathematical expressions to communicate understanding or to ask questions
- Read scientific and engineering text, including tables, diagrams, and graphs and explain the key ideas being communicated
- Recognize the major features of scientific and engineering writing and speaking and produce written and illustrated text or oral presentations that communicate their own ideas
- Engage in a critical reading of primary scientific literature or media reports and discuss the validity and reliability